Research in Autism Spectrum Disorders 77 (2020) 101612

Contents lists available at ScienceDirect

Research in Autism Spectrum Disorders

journal homepage: www.elsevier.com/locate/rasd

A systematic review of how emotional self-awareness is defined and measured when comparing autistic and non-autistic groups

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ARTICLE INFO

Number of reviews completed is 2

Keywords:
Alexithymia
Autism
Emotional self-awareness
Emotion differentiation

ABSTRACT

Background: Poor emotional self-awareness, often referred to as 'alexithymia' may be a common area of difficulty in autism. However, emotional self-awareness is labelled and defined differently in various strands of research, and is often measured by self-report. These issues may influence differences in emotional self-awareness between autistic and non-autistic groups. Thus, we need to examine how emotional self-awareness is defined and measured in this literature.
Method: We systematically reviewed studies comparing emotional self-awareness in autistic and non-autistic participants. Forty-seven papers were identified for inclusion, and how emotional self-awareness was defined was extracted from each. Thematic analysis was conducted on extracted definitions. The measurement tools used in each paper were also reviewed, to assess the extent to which studies are reliant upon self-report.
Results: We identified seven key themes in definitions of emotional self-awareness, with little consistency. Also, the themes identified mapped poorly onto the tools used to measure them. Most studies relied exclusively on self-report, and few used more than one tool. Only three behavioural measurement tools were identified.
Conclusion: Emotional self-awareness has been variably defined by researchers in different strands of autism research. Moreover, most studies exclusively use self-report alone to measure this outcome, and this may not be reliable. To account for the multi-faceted nature of emotional self-awareness, future research would benefit from specifically defining which aspect of emotional self-awareness is under study and utilising multi-method approaches.

1. Introduction

Our emotions are important features of everyday life, informing and shaping our actions and social interactions. Recent theoretical work suggests that emotions are constructed, inferred from interoception (the sense of the internal body), as well as external context and prior learning (Barrett, 2017; Seth, 2013). More importantly, how emotion is constructed varies from person to person (Barrett & Satpute, 2019) - some experience and label emotions in discrete, differentiated manner, such as being able differentiating between 'disappointment' and 'anger', while others have a 'fuzzier' awareness, limited to a general sense of valence and intensity ('good' or 'bad'). In extreme cases, some may not be able to recognise their own emotions at all (Lane, Ahern, Schwartz, & Kaszniak, 1997).

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https://doi.org/10.1016/j.rasd.2020.101612
Received 6 December 2019; Received in revised form 30 June 2020; Accepted 7 July 2020

Many different constructs have arisen in psychology to describe this ability to identify and understand one's own emotions (Kashdan, Barrett, & McKnight, 2015), but in this review we shall broadly refer to it as 'emotional self-awareness'. At this point our definition of emotional self-awareness remains intentionally vague, as a key aim of this review is to examine the range of definitions used within the literature to arrive at a consensus position.

Current research suggests that variability in emotional self-awareness predicts social and emotional outcomes, including greater emotional regulation and empathy (Smidt & Suvak, 2015). Emotional self-awareness difficulties are common in autism (Kinnaird, Stewart, & Tchanturia, 2019), and such difficulties are suggested to predict emotional contagion and emotion recognition abilities in this population, potentially more so than autistic symptoms (Bird & Cook, 2013). As such, emotional self-awareness may be a key target for intervention and research within autism.

The notion that autistic people have greater difficulties understanding their own emotions is not new. Early Theory of Mind work suggested that autistic people struggle to represent their own mental states as much as the mental states of others (Perner, Frith, Leslie, & Leekam, 1989). Review work has found that autistic children have difficulties reporting their own intentions, beliefs, and knowledge, particularly if these contradict feedback from the environment (Williams, 2010). Furthermore, it has been proposed that emotional self-awareness difficulties, as conceptualised by alexithymia, may account for some of the emotional difficulties commonly seen in autism (Bird & Cook, 2013), and that these are dissociable from core diagnostic symptoms of autism. Studying emotional self-awareness in autism allows us to examine the extent to which emotional self-awareness may be dissociable from general communicative abilities. Accordingly, emotional self-awareness has become an increasingly prominent topic of study in autism over the past decade, largely though the study of alexithymia (Bird & Cook, 2013).

Alexithymia is a construct from the psychosomatic literature, broadly referring to difficulties identifying and describing one's own emotions, among other things (Sifneos, 1973). Small, early studies found higher self-reported alexithymic traits in autistic adults compared to comparable neurotypical controls (Berthoz & Hill, 2005; Hill, Berthoz, & Frith, 2004; Tani et al., 2004). More recently, a meta-analysis confirmed that these differences are consistent across studies (Kinnaird et al., 2019), with autistic adults reporting much higher levels of alexithymia than their neurotypical peers.

In studies with autistic adults, alexithymia scores correlate with diminished facial emotion recognition (Cook, Brewer, Shah, & Bird, 2013; Oakley, Brewer, Bird, & Catmur, 2016) across both autistic and non-autistic groups. Similar effects have emerged for ability to recognise emotional vocalisations (Heaton et al., 2012), as well as with hypo-activation in brain areas associated with empathy (Bird et al., 2010). These findings suggest that alexithymia may predict difficulties with emotional recognition and empathy in autism.

In these studies, alexithymia is largely measured through self-report questionnaires. Subjective experiences can only be rated by mentally comparing one's own behaviour and experiences to how other people act and feel. In other words, self-report asks participants whether they consider themselves to have greater or poorer emotional self-awareness than the imagined average. However, it is impossible to know how one's own emotional experiences compare to others, and this can only be inferred through discussing emotional experiences to form an internal model of how one compares to others. As people with autism have social communication difficulties, they may have a weak model of how others experience emotion, and their self-report may be less valid.

To discuss these issues in further detail, it is helpful to place alexithymia within its appropriate historical context, tracking how the definition and measurement of the construct has changed since its inception.

1.1. A history of alexithymia and emotional self-awareness

While it may be impossible to truly pin down the beginnings of emotional self-awareness research, the term 'alexithymia' was first coined by Peter Sifneos (1973) to describe a pattern of impoverished imagination, utilitarian thinking, and communication difficulties that he observed in his psychosomatic patients. These difficulties made such patients ill-suited to the traditional psychoanalytic treatments of the time, making identification of these individuals an important issue.

Notably, these original descriptions of 'alexithymia' bear a resemblance to common features of autism. The diagnosis of autism is based on difficulties within 'social-emotional reciprocity' particularly in terms of reduced sharing of emotion and difficulties in non-verbal communication (American Psychiatric Association, 2013), similar to the communication difficulties and external cognitive style Sifneos observed. Moreover, Sifneos' work was published before autism was widely viewed as a 'spectrum' condition that can affect adults and children without intellectual disability. This raises the possibility that Sifneos' original observations were based on adults who would now attract a diagnosis of autism, hence the overlap with many common autistic traits.

Alexithymia was popularised through two conferences centred on the construct. Proceedings from the latter conference were published as a special edition of the journal 'Psychosomatics and Psychotherapy' (Sifneos, 1977), providing an empirical research base for the construct. Moreover, the impressive speed at which 'alexithymia' was adopted into use likely reflects both the utility and clinical resonance of Sifneos' original observations. Undoubtedly, the term was, and remains, a useful way to describe a set of clinically important behaviours.

Yet scholars warned that the alexithymia construct was at risk of reification (Lesser & Lesser, 1983; Wolff, 1977). At this stage, alexithymia had yet to be fully validated as a stable personality trait, and doubt remained about whether it reflected one unitary trait that remained stable over time (Lesser, 1981). Moreover, there was a great deal of inconsistency in how alexithymia was measured and operationalised (Ahrens & Deffner, 1986), and measurement tools at the time were noted to be unreliable, poorly validated, and psychometrically weak (Lesser, 1981; Taylor, 1984).

Nevertheless, this early work provided a foundation for extensive further research and the development of a brief, easy-to-administer self-report tool, the 26-item Toronto Alexithymia Scale (TAS-26; Taylor, Ryan, & Bagby, 1985). Given that previous

measurement tools relied on long clinical observation and interview, the ease at which the TAS-26 could be administered and analysed made it easier for researchers and clinicians from different fields to examine alexithymia in their work.

The TAS-26 consists of four key sub-scales, chosen due to their theoretical relation to alexithymia as well as their psychometric robustness. These four subscales were: 1) the ability to identify and distinguish between feelings and bodily sensations; 2) the ability to describe feelings; 3) tendency towards daydreaming and imagination; 4) externally-oriented thinking. The TAS-26 was later revised into the 20-item version (TAS-20; Bagby, Parker, & Taylor, 1994; Bagby, Taylor, & Parker, 1994), which has since become one of the most common ways to measure alexithymia in research. During the revision from the TAS-26 to the TAS-20, the sub-scale assessing imagination and fantasy was eliminated. This omission reflects one way in which the broader construct of the 1970s has become the contemporary construct largely focused on ability to identify and describe emotions. However, the TAS-20 has accumulated an impressive evidence base over the past 25 years demonstrating its psychometric robustness (Bagby, Parker, & Taylor, 2020), and remains one of the most well-validated measures of emotional self-awareness in the literature.

Despite this, some have suggested that the TAS-20 is measures general psychological distress, rather than a unique, stable personality trait (Leising, Grande, & Faber, 2009). TAS-20 scores are strongly associated with negative affect (Leising et al., 2009), as well as scores of depression (Honkalampi, Hintikka, Laukkanen, Lehtonen, & Viinamäki, 2001). Longitudinal studies have likewise found that TAS-20 scores fluctuate with changes in general mental health symptoms, such as anxiety or depression (Marchesi, Bertoni, Cantoni, & Maggini, 2008, 2014).

Nevertheless, neuroscientific evidence supports the validity of both the alexithymia construct, and the use of self-report measures such as the TAS-20. Research has consistently found that higher self-reported alexithymia is associated with hypo-activation in brain areas serving emotion perception (Grynberg et al., 2012) and awareness (Kano & Fukudo, 2013) but hyper-activation in somatic and motor areas in response to physical sensation such as pain (Kano & Fukudo, 2013), as well as greater functional connectivity in these areas (Liemburg et al., 2012). These findings suggest that self-reported alexithymia does reflect meaningful differences in emotional self-awareness, with high alexithymia associated with a focus on 'lower level' aspects of emotional awareness, such as somatic sensitivity (Moriguchi & Komaki, 2013). Moreover, alexithymia has also been associated with somatoform disorders (De Gucht & Heiser, 2003), a well-recognised category of psychiatric disorders, although this is only in comparison to typical populations are not to other psychiatric controls.

As such, whilst the construct has been well-validated as a dimensional trait, it may be more questionable as to whether alexithymia is a 'condition' (Barrett, 2017) or 'disorder' (e.g., Heaton et al., 2012). Although sometimes described as a categorical disorder in research, it is not recognised as a distinct disorder in either the DSM-5 (American Psychiatric Association, 2013) or the ICD-11 (World Health Organisation, 2018). Within research, the majority of participants referred to as 'alexithymic' refer to a subset of participants that fall above a certain cut-off point on the TAS-20, rather than a group that has underwent any formal diagnostic process. While research supports the validity of alexithymia as at trait, describing alexithymia as a condition may be premature and potentially misleading. Alexithymia is well-validated as a dimensional measure of individual differences, but this differs from a categorically defined disorder based on a well-validated pattern of characteristic features. As such, how it is measured and defined within the autism literature may benefit from close examination.

Within the wider emotion literature, emotional self-awareness is conceptualised in many different ways (Kashdan et al., 2015), all with their own strengths and limitations. One popular approach is emotion differentiation (also known as 'granularity'). Closely linked to constructionist theories of emotion (Barrett, 2017), this approach focuses on individual variability in which people apply discrete emotional labels to affective experiences. In other words, how well one can differentiate between similar emotional experiences. Differentiation and granularity are widely regarded as interchangeable terms and are usually measured through experience sampling of an individual's lived emotional experiences (Smidt & Suvak, 2015). The strength of correlation between ratings of similar emotional states are assessed over time, with higher correlations reflecting poorer differentiation between discrete emotional states and thus poorer granularity.

Another approach to emotional self-awareness is the developmental framework proposed by Lane and Schwartz (1987), in which emotional awareness was conceptualised as a cognitive skill that develops in Piaget-like stages. At the most basic level, emotional self-awareness begins with awareness of interoceptive sensation. This progresses eventually to action and general affect awareness, and then to awareness of single discrete emotional states, before finally moving onto more complex blends of emotions. The level at which an individual is performing is usually assessed with the "Levels of Emotional Awareness Scale" (LEAS), a free-writing vignette task in which individuals imagine themselves in various emotional scenarios and describe how they would feel in such a situation (Lane, Quinlan, Schwartz, Walker, & Zeitlin, 1990).

Performance on LEAS tends to correlate only weakly with TAS-20 scores (Maroti, Lilliengren, & Bileviciute-Ljungar, 2018), with some work even finding that greater TAS-20 scores predict better LEAS performance (Versluis et al., 2018). LEAS scores more strongly correlate with differentiation (Smith et al., 2019). This is likely to occur because both differentiation and the LEAS focus on how precisely individuals can use language to label and describe emotional experiences. This also raises the difficulty of whether one can separate core ability to identify one's own feelings from and general language ability.

Another common concept employed within typical populations is emotional intelligence (Salovey & Mayer, 1990), in which emotional awareness and other similar constructs are conceptualised as forms of intelligence. Within this approach, emotional awareness is often split into the concepts of attention (how people attend to and value their own emotions) and clarity (how people identify and label their emotions) (Thompson & Boden, 2019). These tend to be measured through self-report outcomes, although such measures are often integrated into wider emotional intelligence tests (Mayer, Salovey, Caruso, & Sitarenios, 2003). Furthermore, measures of awareness of one's own emotions are often integrated with awareness of other's emotions, making it difficult to distinguish between these outcomes in the resultant data.

While the focus on how individuals label and describe their own emotions is similar to the contemporary alexithymia approach, these approaches differ significantly in how they are measured. In alexithymia studies, emotional self-awareness is often exclusively measured with self-report. Yet in the wider literature, vignette tasks and experience sampling are also seen.

Another concept important to emotional self-awareness is interoception. Interoception is the sense of physiological condition of the body (Craig, 2002), such as ability to detect somatic cues such as heartbeat, muscular and visceral sensations, and pain. Interoception has been theoretically linked to sense of self and bodily ownership (Seth, 2013), and greater sensitivity to interoceptive cues has been associated with greater emotional self-awareness (Barrett, 2014). Interoception has also been theoretically implicated as important in autism, with some accounts suggesting that interoceptive difficulties may underpin a wide array of autistic symptoms (Quattrocki & Friston, 2014), on the assumption that autism is associated with diminished interoceptive abilities. Despite this, empirical findings on interoception in autism tend to be equivocal (DuBois, Ameis, Lai, Casanova, & Desarkar, 2016). Some studies find no significant differences in interoceptive accuracy between autistic and non-autistic groups (Schauder, Mash, Bryant, & Cascio, 2015; Faillia et al., 2020), and other find diminished interoception in autism only on certain tasks (Palser, Fotopoulou, Pellicano, & Kilner, 2018), or on self-report outcomes (Fiene & Brownlow, 2015). Other scholars have suggested that any interoceptive difficulties in autism may be accounted for by elevated alexithymia (Hatfield, Brown, Giummarra, & Lenggenhager, 2017), with some empirical findings supporting this assertion (Shah, Hall, Catmur, & Bird, 2016).

While interoceptive ability is likely to be closely related to emotional self-awareness, it is not itself a direct measure of emotional self-awareness. As such, while physiological measures may be a useful way to measure emotional self-awareness (as seen in Gaigg, Cornell, & Bird, 2018), we decided not to explicitly include interoception studies alone as measures of emotional self-awareness.

Overall, the wider literature suggests that emotional self-awareness may be a frequent area of difficulty in autism and that these difficulties may be clinically and theoretically important. However, there are overlapping and yet disparate strands of research, such as those investigating alexithymia and granularity, and the relationships between them are unclear. Therefore, to assess whether emotional self-awareness is diminished in autism, we must first examine how it is defined and measured in research comparing autistic and non-autistic groups.

1.2. The current review

This report presents the first part of a systematic literature review examining emotional self-awareness in autism. The review was initially designed to examine group differences in emotional self-awareness but the challenge arose of defining this term and its scope, and so this paper aims to address that specific problem. Due to the volume of qualitative data addressing this question, we concluded that this should constitute its own paper. Therefore, in this report we examine the conceptual basis employed, and methodological quality of existing research pertaining to emotional self-awareness in autism. A second report will cover the findings of these studies. As such, the scope of this review is limited to studies with typical comparison groups.

2. Research questions & aims

1 How is emotional self-awareness *defined* in autism research?
   a Systematically review how emotional self-awareness is defined in papers comparing group differences in emotional self-awareness between autistic and non-autistic groups.
   b Identify main themes of emotional self-awareness definitions used in research.
2 How is emotional self-awareness *measured* in autism research?
3 Systematically review which measurement tools are used when comparing group differences in emotional self-awareness between autistic and non-autistic groups.
4 Examine proportion of studies which use self-report measures compared to other tools, such as observer-report or behavioural measures.

3. Methodology

The current review followed PRISMA guidelines for systematic reviews. The protocol for the current review is registered on the PROSPERO database (identification number CRD42017082052), available online at https://www.crd.york.ac.uk/PROSPERO/display_record.php?RecordID = 82052. Quantitative meta-analyses of group differences can be found in a separate report (Huggins, Donnan, Cameron & Williams, in prep).

3.1. Eligibility criteria

Inclusion criteria were as follows: (a) the sample included participants of any age with a diagnosis of autism, including Autism, Asperger's, Pervasive Developmental Disorder Not Otherwise Specified, and Autism Spectrum Condition; (b) the sample included a control group of healthy, non-autistic participants of any age; (c) the study included at least one measure *explicitly* assessing awareness of one's own emotional states. This is defined as the ability to be aware of one's own emotional states, including the abilities to identify, differentiate between, or describe one's own emotions. Furthermore, this measure must be clearly distinct from measures assessing the ability to identify or describe other people's emotions. Finally, measures of interoception, such as the heartbeat perception task, were not included. While theoretically relevant, these measure awareness of physical feelings that are

distinct from emotion (see Pace-Schott et al., 2019, for a review), and were thus not included in this review.

Items were excluded based on the following criteria: (a) study was not published in English, (b) study was not an empirical paper published in a peer-reviewed journal, (c) study did not include at least one measure specifically assessing the construct of interest, as defined above, or (d) study matched autistic and non-autistic groups on emotional self-awareness. Excluding studies without a comparison group or those that matched groups on emotional self-awareness was conducted for the benefit of the quantitative meta-analysis, which can be found in a separate report (Huggins, Donnan, Cameron, & Williams, in prep).

3.2. Search strategy

Searches were conducted on the databases Scopus, Web of Science, ScienceDirect, PsychARTICLES, Embase, Medline, and PsychINFO. The search was conducted across two stages to provide a comprehensive view of the literature. Due to the size of the literature, the first stage only searched abstracts, title, and keywords, and identified key measurement tools. The second stage searched full text of articles for these measurement tools. Searches covered all published reports across all years until May 2018.

In initial searches, databases were searched for any articles which had any combination of the following keywords in the Title, Abstract, and Keywords sections: (1) “autism” or “ASD” or “ASC or “Autism Spectrum Disorder” or “Autism Spectrum Condition” or “autistic” or “Asperger” or “PDD-NOS” or “Pervasive Developmental Disorder Not Otherwise Specified”, and (2) “alexithymia” or “emotional awareness” or “emotional differentiation” or “emotion differentiation” or “emotional granularity” or “emotional intelligence” or “emotional competence” or “emotion labelling” or “emotional labelling”. Terms were based on a review by Kashdan et al. (2015).

Following first stage searches, key measurement tools and related terms were identified. To ensure search was comprehensive, second stage full-text searches using these terms were conducted.

3.3. First stage search strategy and study selection

Abstracts and titles were screened by CH and GD separately, based on eligibility criteria outlined above, and collated at a later date. Disagreements were resolved through discussion.

During title and abstract screenings, 21 papers were excluded for being in a language other than English, 180 for not being empirical papers, 174 for not including a sample of participants with an autism diagnosis, 27 for not including a sample of non-autistic controls, and 43 for not including an explicit measure of emotional self-awareness. Following this, final agreed-upon list of items for full-text screenings was 68.

Full-text screenings were also conducted by CH and GD separately, before being collated at a later date. During full-text screenings 16 studies were excluded for not including any direct measure of emotional self-awareness, 5 for being student dissertations, 2 studies included no typically developing comparison group, 1 item was a conference abstract, 1 item was a study protocol, and 1 was not in English. After excluding these 25 items, 42 items were agreed upon by both researchers. 8 papers were excluded from further analyses as participants were matched by alexithymia, resulting in a final dataset of 34 papers.

Data was extracted through the use of a standardised data extraction form. Prior to extracting the full set, the form was piloted with five articles. Following review the data form was amended to account for comparisons between low and high emotional self-awareness groups. Using the second version of the data extraction form, CH and GD then separately extracted data from the initial set of 34 articles.

3.4. Second stage search strategy and study selection

Following initial analyses, the 20-item Toronto Alexithymia Scale (TAS-20) was identified as the most frequently used measurement tool in the literature. Due to the popularity of the TAS-20 as a tertiary outcome or confounding factor unlikely to be mentioned in the abstract or title, full-text searches were conducted. As a result, 11 further papers were identified for addition to the current dataset. Due to the high amount of papers identified this way, further full-text searches were conducted for all of the identified measurement tools.

Additional search terms can be seen in Supplementary Information, Table A. All search terms combined with previously used autism terms, searching across full-text, abstract, titles, and keywords in all databases, with searches covering all published reports until May 2018. Across these additional searches, only one further paper was identified for inclusion. One additional paper was further identified by word of mouth as it fell only slightly out of the range of searches.

The final dataset consisted of 47 papers. Abbreviated PRISMA flow chart of the search process can be seen in Fig. 1.

3.5. Narrative synthesis

Narrative synthesis was conducted across the full dataset of 47 papers. Participant data items extracted for this synthesis included the number of participants, and their gender ratios, average ages and age ranges, for both autistic and non-autistic groups in each study. Measurement tools were classed as parent-report, self-report or behavioural tasks. Terms were extracted, alongside their definitions when available in the text.

CH conducted thematic analysis on definitions. Definitions were coded twice. The first coding produced an initial set of 9 themes. In the second coding, overlapping themes were combined to minimise repetition and improve robustness, resulting in a total of 7

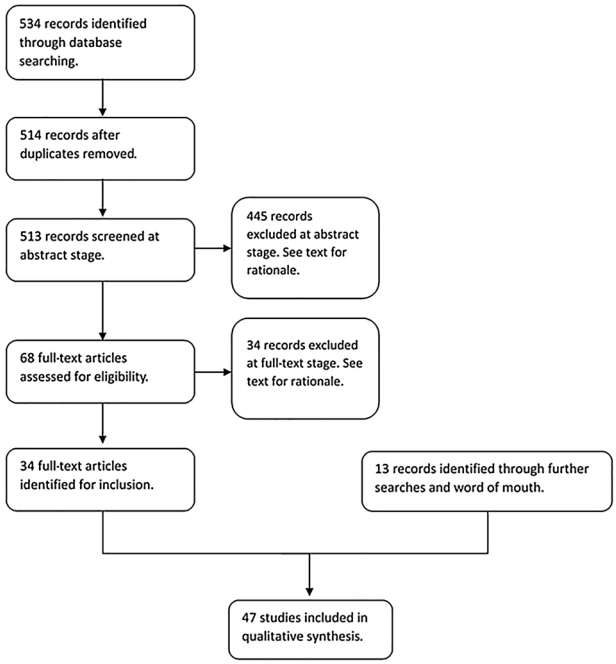

Fig. 1. "PRISMA Flow Chart of Search Process" near here.

themes, outlined below. See Table 1 for extracted definitions and final coding.

4. Results

4.1. Frequencies of terms and tools

34 of the 47 papers used the term 'alexithymia' as the primary term to describe the construct assessed by their measurement tool. Other terms used included emotional awareness (3), emotional intelligence (3), emotion differentiation (1), emotion labelling (1), social cognition (1), emotional processing (1), emotional processing and reflection (1), and awareness of multiple emotions (1). Five studies used multiple terms to describe emotional self-awareness. All five of these studies used 'alexithymia' as a secondary term.

Of the 47 studies included in the current analysis, the majority (41) used only one emotional self-awareness measurement tool. The remaining six used two measurement tools. No studies used more than two tools, and the majority of studies used only self-report tools (42). Two studies exclusively used parent-report tools, and two exclusively used behavioural tasks. Only one study used both self- and parent-report measures.

11 unique emotional granularity tools were identified overall: six self-report, two informant-report, and three behavioural tasks. The most common tool was the TAS-20, a self-report measure used in 29 of papers. The frequencies of each different measurement tool as well as summaries of each can be seen in Table 2.

Seven studies characterised emotional self-awareness as a personality trait, while three described it as a process. Within the 34 studies that used the term alexithymia, four described it as a deficit, three as a condition, and one as a disorder. Seven studies provided no definition of emotional self-awareness.

4.2. Defining emotional self-awareness

Qualitative analysis identified seven themes frequently used to describe and define emotional self-awareness in the dataset. These were as follows: (a) Identifying Own Emotions; (b) Communicating Own Emotions; (c) Imagination and Externally Oriented Thinking; (d) Interpreting Own Emotions; (e) Interoception; (f) Empathising With and Recognising the Emotions of Others; (g) Differentiating Between Own Emotions. See Table 1 for full set of extracted definitions and codings. Further details of each theme are outlined below.

4.2.1. Identifying own emotions

This first theme refers to the ability to identify that one is having an emotional experience. This reflects the broad ability to consciously recognise that one is experiencing an emotion, and internally represent it in affective terms (e.g., feeling 'good' or feeling 'bad').

Examples of the 'Identifying Own Emotions' theme includes descriptions such as "ability to recognise one's own emotions" (Brezis

Table 1
Definition of the emotional self-awareness construct in each study, highlighting coded themes. (Murray et al., 2017; Rieffe, Terwogt, & Kotronopoulou, 2007; Brady et al., 2014; Patil, Melsbach, Hennig-Fast, & Silani, 2016; Ketelaars, Velt, Mol, Swaab, & van Rijn, 2016; Samson, Huber, & Gross, 2012; Schneider et al., 2013; Berthoz, Lalanne, Crane, & Hill, 2013; Courty et al., 2013; McCrimmon, Matchullis, & Altomare, 2016; Lombardo, Barnes, Wheelwright, & Baron-Cohen, 2007; Dijkhuis, Ziermans, Van Rijn, Staal, & Swaab, 2017; McCrimmon, Climie, & Huynh, 2017; Kopec, Hillier, & Frye, 2014; Boily, Kingston, & Montgomery, 2017; Arellano et al., 2018; Brewer et al., 2016; Brewer, Biotti, Bird, & Cook, 2017; Fan, Chen, Chen, Decety, & Cheng, 2014; Gu et al., 2015; Krach et al., 2015; Lai et al., 2013; Lombardo et al., 2010; Minio-Paluello, Baron-Cohen, Avenanti, Walsh, & Aglioti, 2009; Karbasdehi, Abolghasemi, & Karbasdehi, 2018; Wieckowski & White 2017; Mul, Stagg, Herbelin, & Aspell, 2018).

a. Identifying emotions; b. Communicating own emotions; c. Imagination and externally oriented thinking; d. Interpreting own emotions; e. Interoception; f. Recognising the emotions of others; g. Differentiating between own emotions.

#	Citation	Term	Definition (in text quotations)
1	Murray et al. (2017)	Alexithymia	1. "(difficulties reflecting on and describing one's own emotions)"
2	Miloavljevic et al. (2016)	Alexithymia	1. "Alexithymia is a personality trait" 2. "defined by difficulties in identifying and describing feelings, difficulties distinguishing feelings from the bodily sensations of emotional arousal, and a tendency to focus on external events rather than inner experiences" 3. "a difficulties in cognitively mapping feeling states onto internal bodily responses"
3	Griffin et al. (2016)	Alexithymia	1. "Alexithymia refers to pronounced difficulty in identifying and describing one's own emotions and is associated with an externally oriented focus of thinking" 2. "refers to difficulties an individual has in identifying and describing one's own emotions or feelings, alongside difficulties in distinguishing feelings from bodily sensations, as well as an externally oriented cognitive style of thinking" 3. "specific deficit in self-referential emotion processing"
4	Trevisan, Bowering, & Birmingham (2016)	Alexithymia	1. "difficulties interpreting one's own feeling states" 2. "difficulties identifying and describing one's emotions, lack of awareness that some physical sensations are due to emotions, an 'external thinking' orientation that involves focus on external realities with limited self-reflective thought towards inner experience, and limited imagination and fantasy life"
5	Rieffe, Terwogt, & Kotronopoulou (2007)	Emotional awareness	No explicit definition
6	Tani et al. (2004)	Alexithymia	1. "a multifaceted personality construct with difficulty in identifying and describing feelings, difficulty in distinguishing feelings from bodily sensations of emotional arousal, a constricted fantasy life, and an externally oriented cognitive style"
7	Hill, Berthoz, & Frith (2004)	Emotion processing	1. "difficulties in identifying and describing feelings, difficulties in distinguishing feelings from bodily sensations of emotional arousal; impaired symbolization, as evidence by a paucity of fantasies and other imaginative activity; and a tendency to focus on external events rather than inner experiences" 2. "cognitive processing of emotions"
8	Brady et al. (2014)	Emotional intelligence	1. "intrapersonal emotional intelligence" 2. "the intellectual and reasoning skills required to identify, express, label emotions" 3. "intrapersonal skills (self-regard, emotional self-awareness, assertiveness, independence, and self-actualisation" 4. "intrapersonal EQ (measuring self-awareness and self-expression)"
9	Patil et al. (2016)	Alexithymia	1. "a sub-clinical condition characterised by difficulty in identifying and describing subjective feeling states, difficulty in differentiating feelings from bodily sensations, and diminished affect-related fantasy"
10	Roberts-Collins et al. (2018)	Emotional awareness	1. "an attentional process that serves to monitor and differentiate emotions, locate their antecedents, but ignore the physical arousal that is part of emotional experience" 2. "differentiating between emotions, communicating them to others, identifying their causes and a focus on bodily arousal"
11	Erbas et al. (2014)	Emotion differentiation	1. "ability to differentiate between emotions" 2. "the extent to which individuals understand or have knowledge of their own emotions, investigating their ability to differentiate between different emotional states" 3. ability to make fine-grained distinctions between emotional states"
12	Ketelaars et al. (2016)	Alexithymia	1. "an impairment in identifying and describing one's own emotional state" 2. "ability to identify and describe one's own emotion" 3. "recognising and understanding own emotions"
13	Rieffe et al. (2011)	Emotional awareness	1. "attentional process that serves to monitor and differentiate emotions, locate their antecedents, but ignore the physical arousal that is part of the emotional experience" 2. "emotional awareness also includes attitudinal aspects, such as how emotion experiences are valued and should be expressed"
14	Samson, Huber, & Gross (2012)	1. Emotion labelling 2. Alexithymia	1. "difficulties assessing and labeling their own emotions" 2. "ability to accurately label one's emotional states" 3. "difficulty identifying and describing their emotions"
15	Hagenmuiller et al. (2014)	Alexithymia	1. "personality trait" 2. "ability to recognise and verbally express his feelings, as well as the tendency to focus on superficial events rather than thinking about emotions"
16	Schneider et al. (2013)	Alexithymia	No explicit definition
17	Costa, Steffgen, & Samsson (2017)	Alexithymia	1. "the inability to recognise, describe, and distinguish emotions" 2. "Alexithymia is a transdiagnostic deficit that encompasses difficulties identifying and describing emotions"
18	Berthoz et al. (2013)	Alexithymia	1. "traits related to emotional responsiveness"
19	Courty et al. (2013)	Alexithymia	1. "a multifaceted personality construct that has emerged in line with the idea that deficits in the ability to experience and symbolise emotions can have adverse effects on well-being" 2. "reflect deficits both in the cognitive-experiential domain of emotion response system at the level of interpersonal regulation of emotion ... lacking knowledge of their own emotional experiences, alexithymic individual cannot readily imagine themselves in another person's situation and are consequently unempathic and ineffective in modulating the emotional states of others (Bagby & Taylor quote)"
20	Heaton et al. (2012)	Alexithymia	1. "a disorder characterised by impairments in understanding personal experiences of emotion" 2. "Alexithymia is characterised by difficulties in identifying and describing feelings, difficulties in distinguishing feelings from bodily sensations of emotional arousal, impaired symbolization and a tendency to focus on external events rather than on personal experiences" 3. "types of emotional processing deficit characterised by alexithymia" 4. "emotion processing"

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Table 1 (*continued*)

21	Silani et al. (2008)	1. Emotional awareness 2. Alexithymia	1. "identify and distinguish one's feelings" 2. "Difficulties in emotional awareness characterise the condition known as alexithymia" 3. "subclinical phenomenon marked by difficulties in identifying and describing feelings […] include difficulties in distinguishing feelings from the bodily sensations of emotional arousal"
22	Maisel et al. (2010)	Alexithymia	1. "Alexithymia is formally defined a difficulty in identifying and describing internal emotional states" 2. "diminished capacity for emotional introspection"
23	Brezis et al. (2017)	Alexithymia	1. "ability to recognise one's own emotions" 2. "the inability to identify and describe one's own emotions"
24	McCrimmon, Matchullis & Altomare (2016)	Emotional intelligence	1. "individual's ability to perceive, understand, and reason with emotional information as well as specific emotion-related competencies such as empathy" 2. "set of competencies, related to emotions such as optimism, self-awareness, and self-esteem"
25	Lombardo et al. (2007)	1. Self-consciousness / awareness 2. Alexithymia	1. "more difficulty with identifying and describing their own emotions"
26	Duijkers et al. (2014)	1. Emotional processing 2. Alexithymia	1. "the recognition and regulation of one's own emotions (alexithymia is the deficit in doing this)"
27	Dijkhuis et al. (2017)	1. Social cognition 2. Emotional intelligence 3. Alexithymia	1. "alexithymia has been conceptualised for reduced emotion awareness as expressed in a reduced ability to identify, experience, verbally describe, and reflect on one's own emotions"
28	Allen, Davis, & Hill (2013)	Alexithymia	1. "Impairments in participants' ability to verbalise their emotions (type-II alexithymia)" 2. "reduced awareness of the nature of one's emotions" 3. "lack of fluency in discussing one's emotions" 4. "difficulty in verbalizing emotions"
29	McCrimmon, Climiee, & Huynh (2017)	Emotional intelligence	1. "an individual's ability to perceive, understand, and reason with emotional information as well as specific emotion-related competencies such as empathy" 2. "broad construct reflecting ability to process information about one's self or others" 3. "trait EI is a series of related competencies in emotion-related areas such as optimism, self-awareness, self-esteem, and self-actualisation" 4. "ability to understand, recognised, and communicate their emotions to others"
30	Kopec, Hillier, & Frye (2014)	Alexithymia	1." Alexithymia is a dysregulation of emotion involving several different cognitive an affective features" 2. "difficulties with interpreting and putting words to feeling and distinguishing between feelings and bodily sensations of emotional arousal, as well as externally oriented thinking" 3. "type II alexithymia, meaning that [autistic people] most likely experience a similar range of emotions as people without alexithymia, but lack the ability to verbalize those feelings" 4. "the ability to express one's emotional experience"
31	Berthoz & Hill (2005)	Alexithymia	1. "emotion dysregulation includes difficulties in identifying and describing feelings, difficulties in distinguishing feelings from bodily sensations of emotional arousal, impaired symbolisation, as evidenced by a paucity of fantasies and other imaginative activity, and a tendency to focus on external events rather than inner experiences" 2. "Type I alexithymia is characterised by a low degree of conscious awareness of emotional arousal and a low degree of emotion accompanying cognitions" 3. "Type II alexithymia is characterised by a normal or high degree of conscious awareness of emotional arousal together with a low degree of accompanying cognitions"
32	Boily, Kingston, & Montgomery (2017)	Emotional intelligence	1. "individual differences in processing and solving problems with emotional information" 2. "self-perceived capabilities and various personality characteristics such as optimism and flexibility"
33	Thaler et al. (2017)	Alexithymia	1. "Alexithymia is characterised by difficulties in detecting and describing emotional experiences in the self, and also in recognising others' emotions"
34	Arellano et al. (2018)	Alexithymia	1. "alexithymia (i.e., difficulties in expressing ones emotions)" 2. "Alexithymia describes patients' difficulties in communicating due to the 'inability to find appropriate words to describe their feelings'"
35	Bernhardt et al. (2013)	Alexithymia	1. "a trait characterised by altered emotional interoception and empathy" 2. "subclinical trait associated with reduced emotional awareness and empathising"
36	Brewer et al. (2016)	Alexithymia	No explicit definition
37	Brewer et al. (2017)	Alexithymia	1. "a trait associated with difficulties identifying and describing one's own emotions"
38	Fan et al. (2014)	Alexithymia	No explicit definition
39	Gu et al. (2015)	Alexithymia	1. "higher scores indicate greater difficulty in emotional awareness and greater degree of alexithymia"
40	Katsyri et al. (2008)	Alexithymia	1. "alexithymia, which has been characterised as 'emotional blindness'" 2. "also known to involve difficulties naming emotional facial expressions"
41	Krach et al. (2015)	Alexithymia	No explicit definition
42	Lai et al. (2013)	Self-awareness of own emotions	No explicit definition
43	Lombardo et al. (2010)	Alexithymia	No explicit definition
44	Minio-Paluello et al. (2009)	Alexithymia	1. "a multi-faceted construct encompassing 1) difficulty in identifying, describing, and communicating subjective feelings; 2) difficulties in differentiating feelings from bodily sensations of emotional arousal; 3) diminished fantasy; and 4) stimulus-driven, externally-oriented cognitive style"
45	Karbasdehi, Abolghasemi, & Karbasdehi (2018)	Alexithymia	1. "the inability to identify and describe one's emotional experience" 2. "impaired capacity to consciously experience emotions" 3. "personality trait marked by the reduced ability to consciously experience, label and describe one's emotional state"
46	Wieckowski & White (2017)	Alexithymia	1. "difficulties understanding, processing, or describing emotions"
47	Mul et al. (2018)	Alexithymia	1. "a condition characterised by a reduced ability to recognise, describe and understand one's emotions" 2. "Alexithymia is considered to be a trait" 3. "identify and describe one's own emotions"

Note. Highlighting indicate themes as below.

a. Identifying emotions; b. Communicating own emotions; c. Imagination and externally oriented thinking; d. Interpreting own emotions; e. Interoception; f. Recognising the emotions of others; g. Differentiating between own emotions.

et al., 2017), or "recognition […] of one's own emotions" (Duijkers, Vissers, Verbeeck, Arntz, & Egger, 2014).

4.2.2. *Communicating own emotions*

'Communicating Own Emotions' refers to the ability to communicate one's own emotional states to others. This mostly focuses on

Table 2
Measurement tools frequency and summaries.

Measurement Tool	Type	Frequency	Target Population	Description
Toronto Alexithymia Scale (20 item) [TAS-20]	Self-report	29 †	Adults	20-item self-report composed of three factors: difficulty identifying feelings (DIF), difficulty describing feelings (DDF) and externally oriented thinking (EOT). Intended to assess alexithymia, including tendency to focus on external over internal stimuli. Responses on 5-point scale, summed to calculate total. Some items reverse-scored. Good overall internal consistency and high test-rest reliability (Bagby, Parker et al., 1994), but EOT tends to have unsatisfactory internal consistency (Kooiman, Spinhoven, & Trijsburg, 2002) Scores range from 20 to 100. Higher scores represent lower granularity.
Bermond-Vorst Alexithymia Questionnaire [BVAQ]	Self-report	7	Adults	Self-report questionnaire with a five-factor structure, organised into two components: cognitive and affective alexithymia (Vorst & Bermond, 2001). Responses on 5-point scale, summed to calculate total. Half of the items reverse-scored. Cognitive component composed of 'Identifying emotions', 'Analysing emotions' and 'Verbalizing emotions' subscales. Affective component composed of 'Emotionalizing' and 'Fantasising' subscales. Three versions of the BVAQ in use: 40-item BVAQ-AB, 20-item BVAQ-A, and 20-item BVAQ-B. BVAQ-A and BVAQ-B "parallel" forms, measuring same factors with same number of items. BVAQ-AB scores range from 40 to 200. BVAQ-A and BVAQ-B scores range from 20 to 100. Higher scores represent lower granularity.
Bar-On Emotional Quotient Inventory Intrapersonal Subscale [Bar-On EQ-i]	Self-report	5	Any	Bar-On EQ-I interpersonal scale is subscale of the Bar-On EQ-I, self-report measure of emotional intelligence. Intrapersonal subscale assesses ability to be aware of, express and assess own emotions, as well as self-efficacy and overall positive affect. Intrapersonal subscale scores significantly correlate with TAS-20 scores (Dawda & Hart, 2000) Four versions of the EQ-I exist: the 133 item adult form, the 51 item adult form, the 60 item short youth form, and the 30 item short adult form. Higher scores represent higher granularity
Toronto Alexithymia Scale (26 item) [TAS-26]	Self-report	2	Adults	A 26-item, four-factor version of the TAS-20, including the DIF, DDF, and EOT subscales alongside the subscale 'Reduced daydreaming' (RD). Largely out of use in English speaking world, but still used in some countries where the TAS-20 has not been well-validated. Internal consistency tends to be good, aside from in the EOT subscale (Kauhanen, Jukunen, & Salonen, 1992; Lovko, Gelo, & Karlović, 2015) Higher scores represent lower granularity.
Emotional Awareness Questionnaire – Differentiation Subscale [EAQ]	Self-report	2	Adults	7-item subscale of the six-factor, 30-item EAQ. Responses on three point scale, averaged to calculate total. EAQ-diff shows moderate internal reliability in both child (a = .67) and adolescent (a = .74) populations (Rieffe et al., 2008). Higher scores represent higher granularity.
Children's Alexithymia Measure [CAM]	Other-report	2	Children	14-item parent-report questionnaire, intended for use in children age 5–17. 4-point scale, summed to calculate total. Some items reverse-scored. High internal reliability (a = .92) and good concurrent validity (r = .73) with the Alexithymia Scale for Children (Way et al., 2010). Higher scores represent lower granularity.
Children's Alexithymia Questionnaire [CAQ]	Self-report	2	Children	20-item self-report measure based on the TAS-20, with identical 3-factor structure. Responses on 3-point scale, summed to calculate total. Some items reverse-scored. Internal reliability high for DIF (a = .73) and DDF (a = .75) subscales, but poor for EOT (a = .29) subscales (Rieffe, Oosterveld, & Terwogt, 2006). Higher scores represent lower granularity.

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Table 2 (*continued*)

Measurement Tool	Type	Frequency	Target Population	Description
Multiple Emotions Task [MET]	Behavioural task	1	Children	Children present with four stories of emotional events, and asked to imagine the story happened to them. Two stories designed to evoke positive and negative emotion, two designed to evoke different negative emotions. Children indicate how they would feel in each instance by pointing to four facial expressions (sad, angry, happy, scared), and rating intensity of hypothetical feeling on five-point scale. Number of emotional perspectives identified taken to reflect greater awareness of multiple emotions. High scores represent higher granularity.
Photo Emotion Differentiation Task [PED-task]	Behavioural task	1	Any	Participants view 20 negative emotional images, selected to match 20 discrete negative emotions. Participants how intensely they experienced 20 emotions in response to each image. Intra-class correlation coefficients of consistency calculated between emotion ratings. Higher ICCs reflect less differentiation between emotion terms. ICC scores significantly negatively correlated with DIF subscale of TAS-20, $r = .32$, $p < .05$, although no other correlation between PED-task and TAS-20 scores found (Erbas et al., 2014). Showed no significant correlations with the ES-task (Erbas et al., 2013). High scores represent lower granularity.
Emotion Sorting Task [ES-task]	Behavioural task	1	Any	20 negative emotion terms printed on cards, and participants asked to sort them into groups based on how similar they perceived the emotions to be. More groups indicated greater ability to differentiate between emotions. Showed no significant correlations with the PED-task (Erbas et al., 2013) High scores represent higher granularity.
Alexithymia Questionnaire for Children [AQC]	Other report	1	Children	20-item parent report measure, based upon the TAS-20, for use in children between 5–17 years old. Has identical three-factor model to the TAS-20. Responses on three-point scale, summed to produce total scores. Internal consistency satisfactory in both French ($a = .73$) and German ($a = .86$) versions of the questionnaire (Costa et al., 2017). Higher scores represent lower granularity.

Note. Some tools appear in the same paper.

† One paper did not report the use of the TAS-20 in publication, but did collect unpublished data. This data was shared by the authors with CH.

verbally describing subjective emotional experiences in language, but also can apply to expressing emotions through facial expression, gesture, and tone of voice.

Examples of the 'Communicating Own Emotions' theme includes descriptions such as "describing one's own emotions or feelings" (Griffin, Lombardo, & Auyeung, 2016), "communicating [emotions] to others" (Roberts-Collins, Mahoney-Davies, Russel, Booth, & Loades, 2018), or "fluency in discussing one's emotions" (Allen, Davis, & Hill, 2013).

4.2.3. Imagination and externally oriented thinking

This theme refers to the extent to which people engage in emotion-related fantasy, compared to focusing on external stimuli. Greater emotional self-awareness is associated with greater affect-related fantasy. Poorer emotional self-awareness is associated with an 'externally thinking' orientation, in which individuals focus on external details about the world. This is similar to Sifneos' (1973) original conceptualisation of the externally-oriented thinking aspects of the alexithymia construct, rather than directly to contemporary notions of emotional self-awareness.

Examples of the 'Imagination and Externally Oriented Thinking' theme includes descriptions such as "tendency to focus on superficial events rather than thinking about emotions" (Hagenmuller, Rössler, Wittwer, & Haker, 2014), "external thinking orientation that involves focus on external realities with limited self-reflective thought" (Trevisan, Bowering, & Birmingham, 2016), and "paucity of fantasies and other imaginative activity" (Berthoz & Hill, 2005).

4.2.4. Interpreting own emotions

'Interpreting Own Emotions' refers to the ability to make sense of their emotional experiences in a meaningful way. This refers to the ability to reflect on one's emotional experiences in a meaningful way, understanding the causes of emotional experiences and their impact on future behaviours.

Examples of the 'Interpreting Own Emotions' theme includes descriptions such as "interpreting one's own feeling states" (Trevisan et al., 2016), "capacity for emotional introspection" (Maisel et al., 2016), and "locate [emotion's] antecedents" (Roberts-Collins et al., 2018).

4.2.5. Interoception

'Interoception' refers to the ability to understand the relationship between bodily sensation and emotional experience. This includes the ability to differentiate bodily sensations from emotional experiences, as well as to identify when bodily sensations are caused by emotions.

Examples of the 'Interoception' theme includes descriptions such as "mapping feeling states onto internal bodily responses" (Milosavljevic et al., 2016), "distinguishing feelings from bodily sensations of emotional arousal" (Hill et al., 2004), and "altered emotional interoception" (Bernhardt et al., 2014).

4.2.6. Empathising with and recognising the emotions of others

This theme refers to the ability to identify the emotions of others, as well as to general references to empathy. Examples include "recognising others' emotions" (Thaler et al., 2018), "naming emotional facial expressions" (Kätsyri, Saalasti, Tiippana, von Wendt, & Sams, 2008), and "empathising" (Bernhardt et al., 2014).

4.2.7. Differentiating between own emotions

'Differentiating Between Own Emotions' refers to the ability to make distinctions between similar discrete emotional states. For instance, being able to tell the difference between feeling 'relaxed' and 'happy', or between feeling 'disappointed' and 'angry'. This is similar to the concept of 'emotional granularity' (Barrett, Gross, Christensen, & Benvenuto, 2001).

Examples of this theme includes "differentiate emotions" (Roberts-Collins et al., 2018), "ability to make fine-grained distinctions between emotional states" (Erbas, Ceulemans, Boonen, Noens, & Kuppens, 2013), and "distinguish one's feelings" (Silani et al., 2008).

4.2.8. Frequencies

Across all 47 studies, 'Communicating Own Emotions' was the most common theme identified in definitions of emotional self-awareness, used in 30 (63.8 %) studies. The second most common aspect was 'Identifying Own Emotions' which was identified in 27 (57.5 %) studies. This is followed by 'Interpreting Own Emotions', which was identified in the definitions of 15 (31.9 %) studies each. 'Interoception' was identified in the definitions of 14 (29.8 %) studies.

The 'Imagination and Externally Oriented Thinking' theme was identified in the definitions of only 11 (23.4 %) papers. 'Differentiating Between Own Emotions' was identified in 5 (10.6 %) papers' definitions, and 'Recognising Emotions of Others' was identified in only 3 (6.4 %) papers. A table showing frequency of overlap between themes can be seen in Table 3.

5. Discussion

We set out to systematically review the evidence for a deficit of emotional self-awareness in autism, but we first needed to examine how this construct is conceptualised in this literature. To do so, we conducted thematic analysis of extracted definitions of emotional self-awareness and reviewed the measurement tools used to assess these outcomes. Emotional self-awareness was conceptualised in many ways, indicating it may be best understood as a multifaceted construct, and was primarily measured through self-report. These may have implications for both interpretation of existing findings and development of future research.

Table 3
Observed and expected frequencies with which themes were identified together in the same paper.

	a. Identifying emotions	b. Communicating own emotions	c. Imagination and external orientation	d. Interpreting own emotions	e. Interoception	f. Empathising with and recognising the emotions of others	g. Differentiating between own emotions	Total Frequency of Theme
a.		24 / *17*	10 / *6*	9 / *9*	10 / *8*	1 / *2*	3 / *3*	27
b.			11 / *7*	13 / *10*	12 / *9*	1 / *2*	3 / *3*	30
c.				3 / *4*	10 / *3*	0 / *1*	0 / *1*	11
d.					5 / *4*	0 / *1*	3 / *2*	15
e.						1 / *1*	3 / *1*	14
f.							0 / *0*	3
g								5

Notes: Italics indicates expected frequency of overlap based on total observed frequency for each theme. Expected frequencies rounded up to nearest integer.

5.1. Defining emotional self-awareness

Our review demonstrated that definitions of emotional self-awareness varied throughout the literature, even in studies using the same measurement tool. Analysing the definitions we identified 7 main themes. These mapped onto a broad range of cognitive functions including perception of somatic states ('Interoception'), meta-representation of and attention to emotional states ('Identifying Own Emotions', 'Imagination and Externally Oriented Thinking'), and the linguistic and social communicative aspects of emotion understanding ('Interpreting Own Emotions', 'Communicating Own Emotions', 'Empathising With and Recognising the Emotions of Others').

No single theme emerged in all studies, and no themes appeared consistently with one another. The most common source of overlap is 'Identifying Own Emotions' with 'Communicating Own Emotions', which appeared together in 24 studies – likely due to their relevance to the alexithymia construct. Despite this, only 11 studies defined emotional self-awareness in terms of 'Imagination and Externally Oriented Thinking', and this did not always overlap with 'Identifying' and 'Communicating'.

Two conclusions emerge. Firstly, definitions of alexithymia in autism research have largely moved away from the classic model proposed by Sifneos (1973). As outlined in the introduction, alexithymia was originally defined mostly in terms of a cognitive style which prioritised focus on external events and psychosomatic behaviour, over internal experience. Definitions of alexithymia now focus more on the capacity to demonstrate a conscious awareness of emotions, rather than clinical behaviours indicative of low emotion and high somatisation outlined by Sifneos. Therefore, research may benefit from differentiating between emotional self-awareness as a dimensional construct and somatisation as a clinical problem which may fall more under the rubric of 'classical' alexithymia or somatoform disorders.

Secondly, emotional self-awareness may be better considered as a 'macro' construct with underlying facets. Research using fMRI (Moriguchi & Komaki, 2013) has shown that individual variability is most heavily accounted for by differences in limbic and sensory areas of the brain, rather than prefrontal areas, suggesting that individual differences are largely driven by reactivity of emotion and sensory brain areas to emotional inputs. However, some definitions relate more to complex, cognitive aspects of emotional experience, such as interpreting emotional states, communicating them to others, and empathising with them in others. In addition, linguistic functions are necessary for expression and communication. Therefore, research into emotional self-awareness, including alexithymia, may benefit by specifying which aspect it is examining and including appropriate controls for other aspects.

The frequency of, and overlap between, themes does not necessarily indicate that these are the 'correct' ways to define emotional self-awareness. Rather, these analyses summarise past research trends and demonstrates gaps in the existing literature. For instance, little work has discussed 'Differentiating between emotions', and rarely in tandem with other themes. This does not indicate that differentiation is irrelevant but simply that this avenue has been little explored. Given increasing focus on differentiation as a predictor of socioemotional outcomes (Smidt & Suvak, 2015), this may be a fruitful area of future research.

5.2. Measuring emotional self-awareness

The second aim of the study was to examine how emotional self-awareness is measured in studies comparing autistic and non-autistic groups. As anticipated, measurement was mostly based on self-report questionnaires. Of the 47 studies identified in the review, 42 (89 %) used exclusively self-report measures. The TAS-20 also emerged as the most common measurement tool, used in 62 % of total studies. Behavioural measurement tools were the least common – only three were identified, and each was only used once.

While most measurement tools at least partially reflected the definitions used by researchers, this was not always the case. For instance, although 'Externally Oriented Thinking' is an explicit subscale of the TAS-20, only 11 of the 29 papers that used the TAS-20 included the theme 'Imagination and Externally Oriented Thinking' in their definition of emotional self-awareness. Three studies

using the TAS-20 also defined emotional self-awareness in terms of 'Recognising the Emotions of Others', and this is not included in any items of the TAS-20. As mentioned above, future research may benefit from ensuring that measurement tool reflects the aspect of emotional self-awareness under examination.

The reliance on self-report measures may be a source of error. Even among typical sociable adults, it is not possible to truly know how one's inner emotional experiences compare to those of others. In line with this, empirical evidence finds that self-reported emotional abilities are only weakly correlated with comparable behavioural measures (Lumley, Gustavson, Partidge, & Labouvie-Vief, 2005; Keefer, 2015). As people with autism may be less likely to discuss their emotions with others, self-report may be particularly unreliable in this population. Self-report also requires general meta-cognitive abilities, which may be adversely affected in autism (Grainger, Williams, & Lind, 2014; Williams, Lind, & Happé, 2009; Zalla, Miele, Leboyer, & Metcalfe, 2015). Finally, people with low emotional self-awareness may have more general difficulties with self-awareness, and thus may struggle to accurately report on their feelings. Therefore, using self-report measures to determine group differences in emotional self-awareness may be inherently problematic (Marchesi et al., 2014).

The TAS-20 was used as the primary measure of emotional self-awareness in over half of the total sample. As previously discussed, the TAS-20 has been criticised due to its strong association with general negative affect (Lumley, 2000). TAS-20 scores also fluctuate in line with mental health symptoms (Marchesi et al., 2008, 2014), raising concerns that the TAS-20 may measure psychological distress, rather than a stable trait (Leising et al., 2009). Moreover, autistic people show high rates of mental health conditions such as anxiety and depression (Simonoff et al., 2008), as well as poorer life satisfaction (Schmidt et al., 2015). As such, TAS-20 scores in autism may be elevated by co-morbid mental disorders and greater negative affectivity in the population, rather than by stable differences in emotional self-awareness.

Nevertheless, there are many advantages to using self-report questionnaires and a great deal of evidence supports the validity of the TAS-20 (Bagby et al., 2020). Moreover, behavioural measures also come with limitations – they are often not as well-validated and can be difficult to implement. Furthermore, in the case of emotional self-awareness, behavioural measures are just as reliant on inference. However, our review has demonstrated that the existing evidence base for emotional self-awareness in autism is very heavily based on self-report measures. Consequently, the limitations of evidence from self-report measures are not overcome by supportive evidence using other methodologies.

As discussed in the introduction, self-reported alexithymia has been associated with both neural and behavioural differences, in particular hypo-activation in response to emotional stimuli and elevated responses to somatosensory and sensorimotor stimuli (Moriguchi & Komaki, 2013). As such, self-report measures such as the TAS-20 may largely be capturing individual differences in attention and reactivity to emotional inputs and not be tapping into individual differences in 'higher level' aspects of emotional self-awareness, such as interpretation or labelling. Capturing individual differences in these more complex abilities may necessitate use of alternate measurement tools.

Developing more behavioural methods of assessing emotional self-awareness is therefore a goal of current research. In the current review, only three behavioural methods were identified: the Photo Emotion Differentiation task (PED-task), the Emotion Sorting task (ES-task), and the Multiple Emotions Task (MET), see Table 2 for details.

Of the three behavioural tasks identified in the current study, the PED-task seems the most feasible for measuring emotional self-awareness. While the ES-task may rely on semantic knowledge of emotion terms, rather than actual emotional experiences, the PED-task aims to examine real emotional experiences. The PED-task also allows for more complex responses than the MET, which may only be appropriate for younger children or assessing basic capacity. It also bears strong similarities to experience sampling paradigms (Barrett et al., 2001; Kashdan & Farmer, 2014). Despite this, the PED-task has some potential statistical issues. A recent meta-analysis of PED-task datasets found that 7.5%–42.6% of scores were uninterpretable and subsequently excluded (Erbas et al., 2019). Thus, depending on type of statistical analysis used, the PED-task can result in large amounts of missing data. Further work is needed to address these potential issues before this task can be widely implemented.

Notably, no papers in our dataset utilised either experience sampling methods or the Levels of Emotional Awareness Scale (LEAS; Lane et al., 1990). This may reflect the practical challenges they pose in autistic populations. The LEAS relies on written reports of emotional experiences, requiring participants to imagine themselves in emotional situations. These verbal and imaginative demands may make it difficult for many autistic participants. Experience sampling tends to be longitudinal and places a high-burden on participants, and thus may be challenging to successfully implement in autistic samples given high rates of mental illness, difficulties with executive function, and needs to adhere to routine common in this population. All the same, the absence of these two measures represents a significant inconsistency with the wider emotion literature. Future research may benefit from adapting these two methodologies for use in autistic samples.

5.3. Implications and future directions

There is a strong theoretical precedent for the notion that emotional self-awareness is diminished in autism. As discussed in the introduction, the original observations made by Sifneos (1973) bear some resemblance to how autism tends to manifest in intellectually able adults, raising the possibility that emotional self-awareness difficulties may be a central characteristic of autism. Diagnosis of autism rests on "deficits in social-emotional reciprocity….", including "…reduced sharing of interests, emotions, or affect" and "deficits in nonverbal communicative behaviours used for social interaction" (American Psychiatric Association, 2013). In most widely accepted diagnostic instrument in research and clinical practice, the Autism Diagnostic Observation Schedule (ADOS), impaired communication of social affect is the main factor onto which items load in the diagnostic algorithm (Gotham et al., 2011). This includes items such as directed facial expression, gesture, shared enjoyment and social reciprocity.

Therefore, whilst the diagnosis of autism does not explicitly include emotional self-awareness, it seems unlikely that emotion self-awareness would be typical in individuals with such widespread and diagnostic weaknesses in emotional expression, sharing and understanding. Furthermore, some of the themes identified in our review may be affected by autism symptoms. For instance, due to the general social communication difficulties inherent in autism, it is likely most autistic people would show greater difficulties with Communicating Own Emotions.

Cognitive research also supports the case for a strong overlap between autism and emotional self-awareness. Theory of Mind difficulties in autism are argued to extend to difficulties with Theory of Own Mind, indicating that autistic populations often have difficulty clearly representing their own mental states (Williams, 2010), and such difficulties seem likely to extend to representing one's own emotional states. In addition, our review of the emotional self-awareness concept indicates that it is most frequently defined and measured in terms of attention to emotional experiences. Autism is associated with diminished attention to emotional stimuli, including human faces (Jones, Carr, & Klin, 2008; Klin, Jones, Schultz, Volkmar, & Cohen, 2002), biological motion (Klin, Lin, Gorrindo, Ramsay, & Jones, 2009), and emotional words (Corden, Chilvers, & Skuse, 2008; Gaigg & Bowler, 2009). This lack of attention to external emotional stimuli may also extend to internal emotional experiences. Therefore, the previously observed difference in self-reported alexithymia between autistic and non-autistic groups (Kinnaird et al., 2019) is unlikely to be wholly the product of confounding factors. However, the weaknesses identified in this review may be exaggerating the extent of these differences, and thus warrant closer examination.

We have demonstrated that there is a marked paucity of behavioural methods of assessing emotional self-awareness and previous work has similarly discussed the need for more objective ways to measure it (Bird & Cook, 2013; Hobson, Brewer, Catmur, & Bird, 2019). However, our review is the first to quantify the extent of the problem, finding that as many as 89 % of studies only measure emotional self-awareness through self-report. Moreover, this is rarely in conjunction with other methods. These issues should be addressed in future research through the development of more objective measures of emotional self-awareness and greater use of mixed-method approaches.

Measuring the ability to identify or differentiate between emotions separately from ability to communicate emotions may be particularly important in autism research, as this would allow us to differentiate emotional self-awareness difficulties in autism from general communication difficulties. One possibility is to examine discrepancy between self-reported and physiological cues of emotion (e.g., Gaigg et al., 2018). Psychophysical approaches have proved useful in assessing sensitivity to the facial emotional cues (Marneweck, Loftus, & Hammond, 2013), and can be similar applied to sensitivity to own emotions through examining patterns in emotional decision making (Huggins, Williams, & Cameron, 2018).

Our review may have implications for practice and intervention. As emotional self-awareness may predict socioemotional outcomes such as emotion recognition and empathy, developing more robust measurement tools may be useful for clinical practice. Utilising the themes developed in this study may also help more precisely target areas of difficulty in autistic patients, and more effectively tailor intervention styles. For instance, emotion differentiation has been found to predict better and more adaptive emotional regulation skills (Barrett et al., 2001). For autistic people with significant emotional regulation difficulties, being able to specifically measure and improve differentiation abilities may be particularly beneficial. Finally, developing specific and targeted behavioural measurement tools in research will allow us to better understand at what level emotional self-awareness difficulties arise, and how this may impact autistic people's health and well-being.

5.4. Limitations

There are some limitations to our review that warrant consideration. Firstly, we exclusively examined studies that included a non-autistic control group. This was due to the review originally being conceived as a meta-analysis comparing group differences, with this part of the study presented in a different report (Huggins, Donnan, Cameron & Williams, in prep). As a result of this, 29 studies were excluded. Potentially, studies with only autistic participants may have used different measurement tools in assessing emotional self-awareness, and thus our review may not be completely comprehensive. However, our findings are still useful in addressing how conceptual and measurement issues may impact upon findings of differences in emotional self-awareness between autistic and non-autistic groups, which was the key aim of the study.

Furthermore, our review excluded measures of interoception and measures that did not distinguish emotional self-awareness from ability to identify the emotions of others. Despite this, interoception and the recognition of other's emotions still emerged as themes. While these exclusions were intended to make the review more specific to emotional self-awareness, more examples of these themes may have emerged with more lenient exclusion criteria.

6. Conclusions

Our review identified overlaps and disparities between several strands of research investigating emotional self-awareness in autism, and demonstrates the need for a more coherent model before we can examine group differences between autistic and non-autistic populations. Moreover, we demonstrated that the majority of research is based on self-report questionnaire. The methodological issues in self-report questionnaires may result in emotional self-awareness difficulties in autism being exaggerated by co-morbid mental health issues and meta-cognitive difficulties. With these problems in mind, it may be premature to conclude that emotional self-awareness is significantly diminished in autism, though there are strong theoretical grounds for this to be the case. Our findings suggest that we can best build upon existing research on alexithymia in autism by integrating it with other strands of emotion research into a more complete, multi-faceted model of emotional self-awareness. From this, we can better develop more objective

measurement tools to targeting specific facets of this model.

Acknowledgements

We would like to sincerely thank all the authors who shared their data with us. We would also like to thank Ira Lesser, Taylor Graeme, and Arvid Heiberg for kindly sharing their articles for the historical review. Review was conduced as part of CFH's PhD studies. We would like to thank the Northwood Trust, UK for their financial support for this research.

Research data available upon request from first author.

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